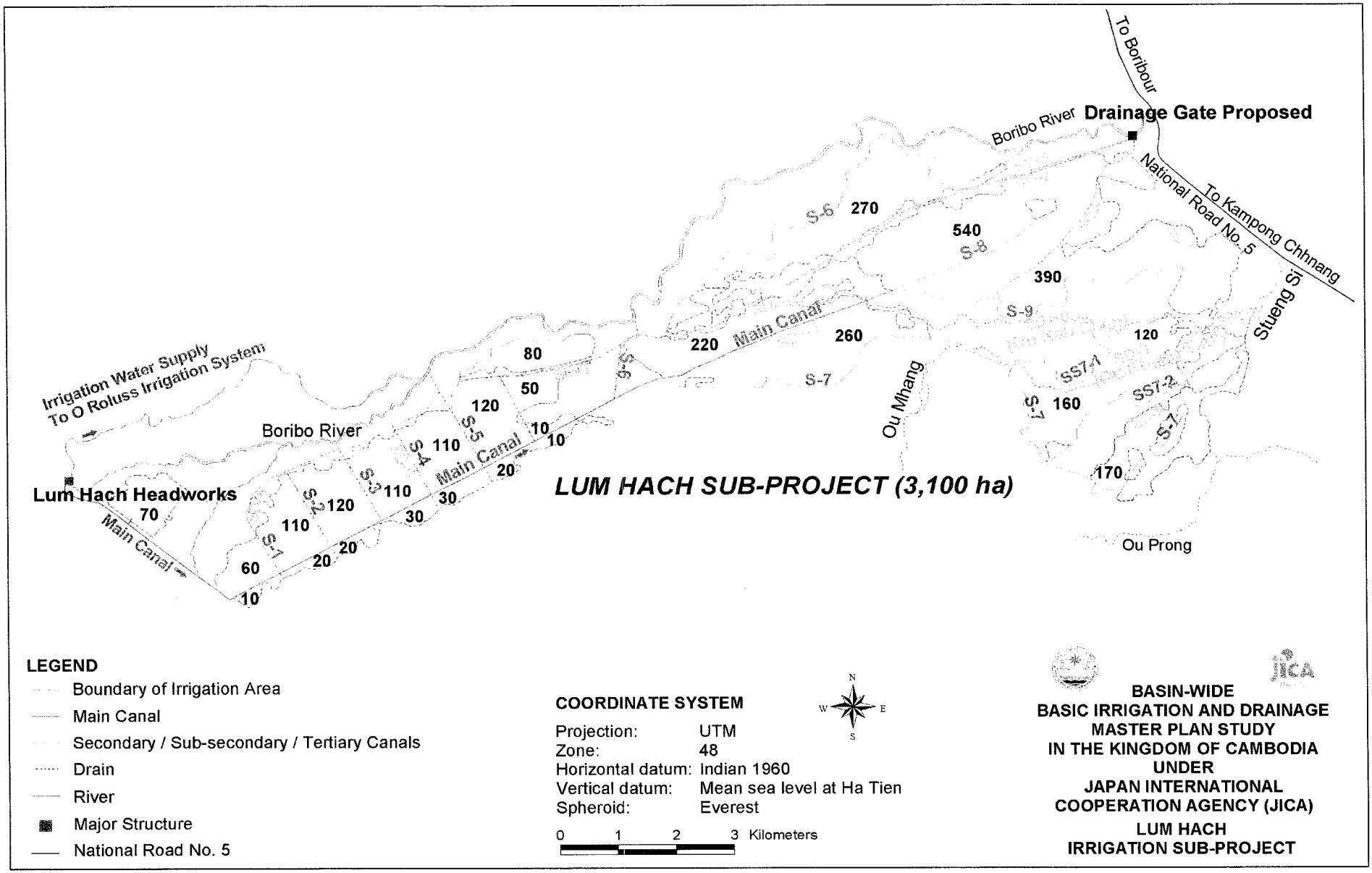
INITIAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LUM HACH REHABILITATION SUB-PROJECT
BORIBO RIVER BASIN
KAMPONG CHHNANG PROVINCE

DECEMBER 2008

MINISTRY OF WATER RESOURCES AND METEOROLOGY

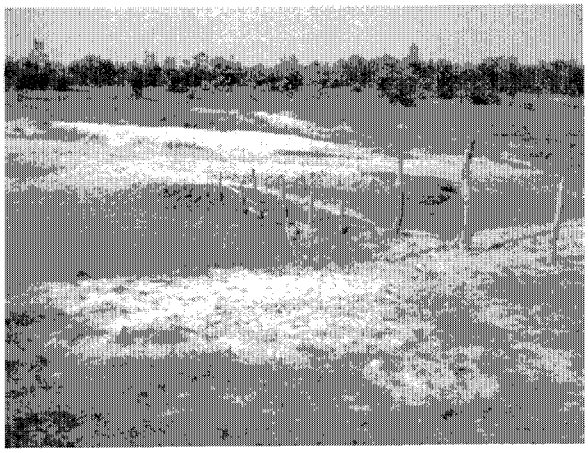
SUPPORTED BY JICA STUDY TEAM
ON
BASIN-WIDE BASIC IRRIGATION AND DRAINAGE MASTER PLAN



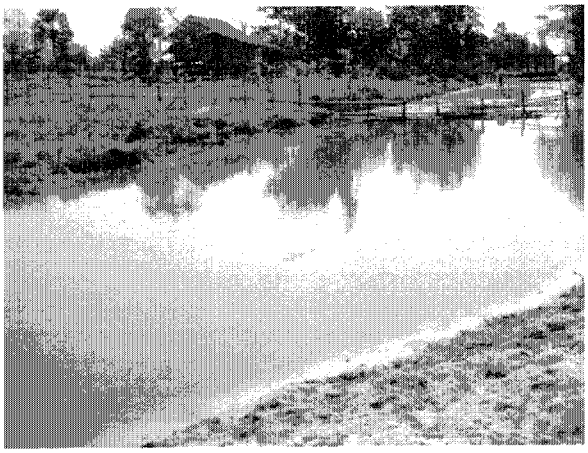
Irrigation and Drainage Canal Layout of Lum Hach Rehabilitation Sub-prject

Environment-Related Features

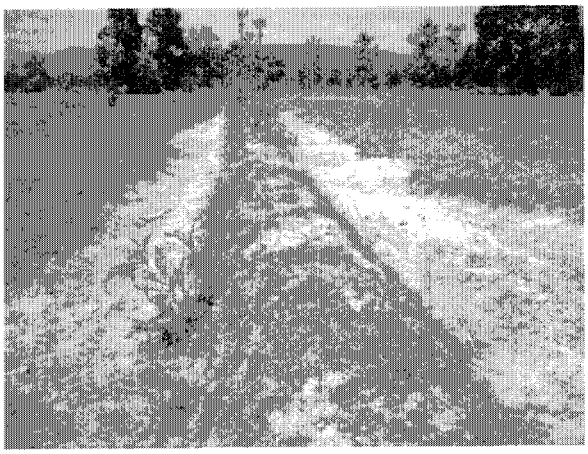
Lum Hach Rehabilitation Sub-Project (Boribo River Basin)



Existing Temporary Check Structure constructed by Farmers
(January 29th 2008)

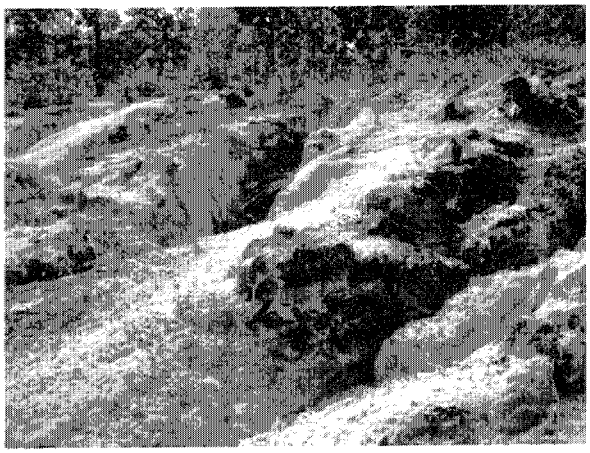


Fish Feeding in the Part of Main Canal in the Illegal Manner
(January 29th 2008)



Bund Observed as Demarcation, but No Tertiary Canals Developed at Present
(January 29th 2008)

Poor Road Network in the Command Area particularly during the Wet Season
(September 4th 2008)

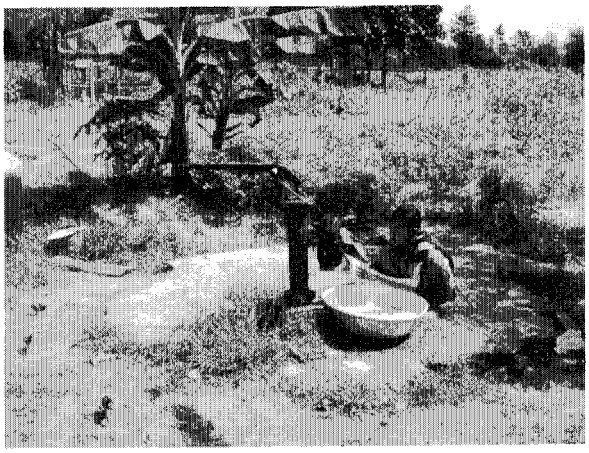


Severe Gully Erosion Due to Dispersive Sandy Soil in the Command Area
(January 29th 2008)

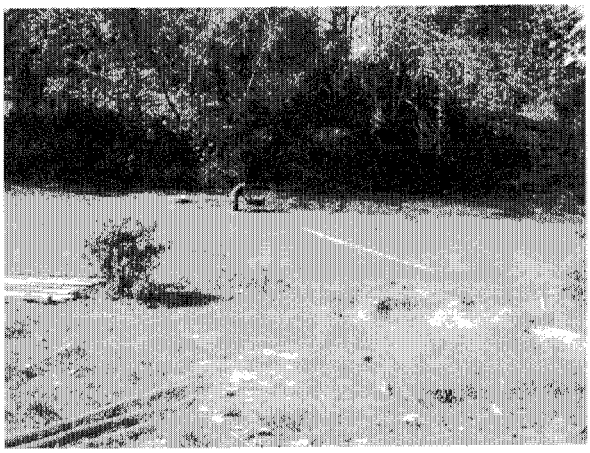
Water Quality Analysis for the Main Canal Water
(June 14th 2008)

Environment-Related Features

Lum Hach Rehabilitation Sub-Project (Boribo River Basin)

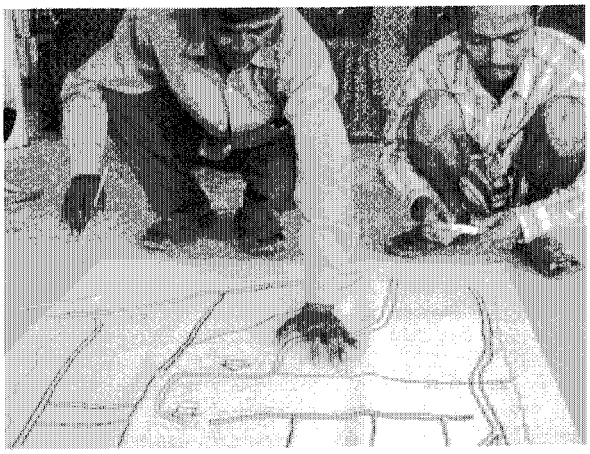


Tube Well for the Domestic Water Source of Villagers
(September 5th 2008)



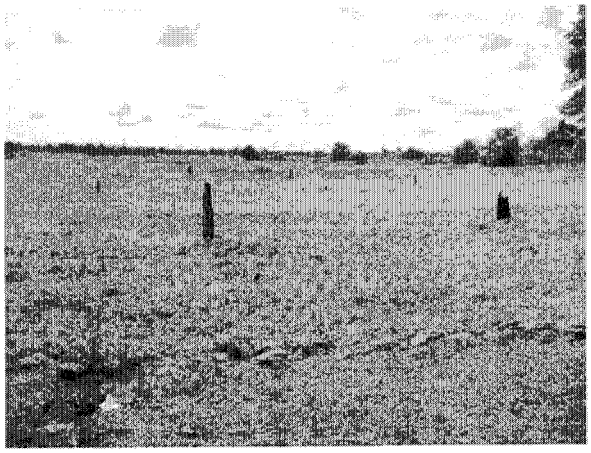
Boribo River as one of the Domestic Water Source by Farmers
(January 29th 2008)

Interview with Farmer to Grasp Current Environmental Constraints
(August 9th 2007)



Resource Mapping Discussed in the Public Consultation Meeting by Representative Farmers
(January 28th 2008)

Typical Temporary House in the Upstream Area to be Submerged by the Reconstruction of Headworks
(September 5th 2008)



Grazing Land to be Submerged by the Reconstruction of Headworks
(September 5th 2008)

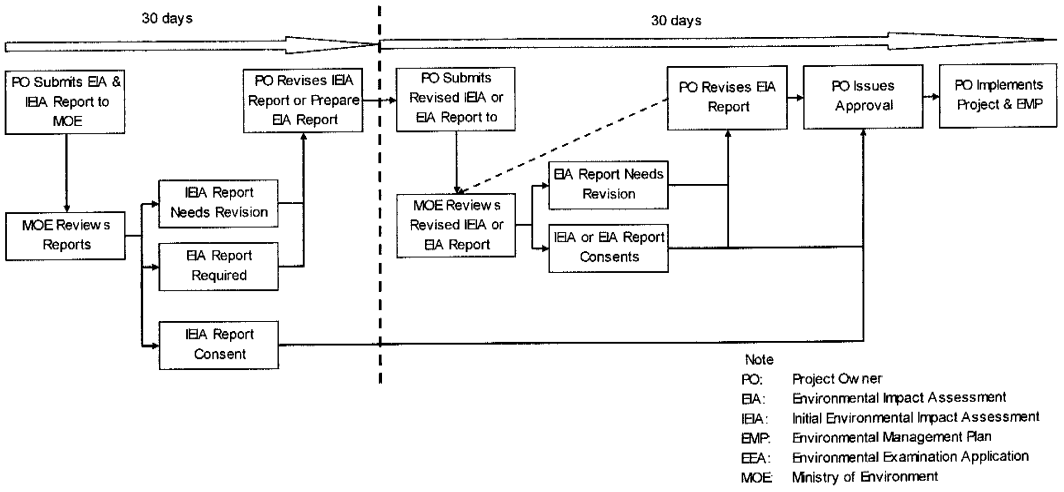
EXECUTIVE SUMMARY

Introduction

01. This Initial Environmental Impact Assessment Report (IEIA Report) for Lum Hach Rehabilitation Sub-Project is prepared based on field reconnaissance, discussion with officials, consultation with farmers and quantitative data collected from relevant institutions. The report consist of: (i) environmental impact assessment system in Cambodia, (ii) methodology of IEIA study applied, (iii) outline of proposed sub-project, (iv) present environmental conditions, (v) stakeholders' opinions, (vi) result of IEIA, (vii) environmental management plan, (viii) comparison between "With" and "Without" conditions, (ix) institutional development plan and (x) conclusion.

Environmental Impact Assessment System in Cambodia

02. The Study has been carried out on the basis of relevant environmental laws and regulations including: (i) law on Environmental Protection and Natural Resource Management and Sub-Decrees, (ii) Environment-related Policies and Plans, (iii) land law and (iv) resettlement policy. Following figure shows procedure of environmental impact assessment stipulated in the Sub-Decree on Environmental Impact Assessment Process.



Procedure of Environmental Impact Assessment

The Sub-Decree instructed that irrigation system with more than 5,000 ha needs IEIA for the review and approval by the Ministry of Environment (MOE). Although target area of Lum Hach Sub-Project is 3,100 ha, IEIA has been carried out through the discussion with relevant agencies assisted by JICA Study Team on Basin-Wide Basic Irrigation and Drainage Master Plan so as to ensure environment sustainability in and around the sub-project areas.

Methodology of IEIA Study Applied

03. IEIA was carried out through stakeholder consultation primarily consisting of: (i)

Interview Survey and (ii) environmental discussion in the workshop, (iii) field reconnaissance and (iv) analysis of existing data.

Outline of Proposed Sub-Project

04. Location and component of the Lum Hach Sub-Project is as follows:

Location of the Sub-Project

Item	Description		
1.1 Location	District	Commune	Village
	Boribo, RoLeaPha-ea	AnChagnRoung, PonLey, PoPel, ProSneb, and other 7 communes	TaingPrich, Prosneb, Taing Thneum, Kdol, and other 27 villages
1.2 River basin/ water source	Boribo river basin/ Boribo river		
1.3 Target group	1) Number of household = 2,066 (Wet season medium- paddy) 2) Staff of PDOWRAM and PDA		
1.4 Objective of the project or program	1) Enhancement of rice production through rehabilitation of Lum Hach Headworks and existing irrigation system		
1.5 Type of project or program	1) Rehabilitation of existing irrigation system		
1.6 Objective area	3,100 Ha		

The Lum Hach Sub-Project is located in Bakan District in Kampong Chhnang Provice. Command area spread to 3,100 ha in total. Water is regulated at the Boribo River by constructing the headworks.

Irrigation and Drainage Rehabilitation Plan for Lum Hach Rehabilitation Sub-Project

No.	Description	Area and/or Number
1.	Sub-project area (Ha)	3,100
	(Pump irrigation area included above)	(410)
2.	Annual irrigation area (Ha)	4,700
	- Early wet season paddy (Ha)	1,300
	- Medium wet season paddy (Ha)	3,100
	- Dry season paddy (Ha)	300
3.	Major water source	Boribo River
	- Name of headworks	Lum Hach (Reconstruction)
	- Intake water level (EL. m)	38.00 - 36.00
	- Diversion water requirement at intake (m3/sec)	6.60
4.	Main canals (nos.)	1
	- Total length (km)	16.4
	- Capacity (m3/sec)	1.98 – 6.60
5.	Nos. of secondary canals	11
	- Total length (km)	42.4
	- Capacity (m3/sec)	0.23 – 1.15
6.	Number of Tertiary Blocks (No.)	67
	Total length of tertiary canals (km)	67
7.	Main drains	Boribo River
	- Total length (km)	-
	- Capacity (m3/sec)	Natural Stream
	- Drainage water requirement from paddy field (lit/sec/ha)	6.83

No.	Description	Area and/or Number
	- Drainage water requirement from other land (lit/sec/ha)	0.025~0.019
8.	Secondary drains (nos.)	11
	- Total length of secondary drains (km)	53.9
	- Capacity (m3/sec)	1.19 – 3.96
9.	Collector drains (nos.)	0
	- Total length of collector drain (New, km)	0
	- Capacity (m3/sec)	-

Prepared by JICA Study Team

Headworks and Major Facilities

Items	Description
-Lum Huch Diversion Weir Design Flood Discharge: Q=430m^3/s (T=100 years) Design Flood Water Level: WL. 38.0m Fish Ladder: B:5.0m x H:3.8m x L:38m	Floating type movable weir -width x height x length B:67m x H:10m x L:44m -Flood Gate: Fixed wheel gate B:15 m x H:4.0m x 3 nos. -Scouring Sluice Gate: Slide gate B:2m xH:3m x 2 nos.
- Lum Hach Intake Design Discharge: Q=6.60m^3/s	-width x height x length B:7.1m x H:3.8m x L:9.5m -Slide Gate: B:1.5m xH:1.5m x 3nos.
- O Roluss Intake Design Discharge: Q=5.70m^3/s	-width x height x length B:5.7m x H:4.8m x L:15m -Slide Gate: B:2.0m x H:1.5mx 2nos.
- Lum Hach Approach Canal Design Discharge: Q=6.60m^3/s (Max.30.0)	-width x height x length B:15m-23m x H:2.0m x L:750 m
- Closure Dyke for 7th January Canal	-width x height B:40m x H:2.4m

Prepared by JICA Study Team

Present Environmental Conditions

05. Sub-project area is a faming community with the dominance of owner farmers. Average land holding is 1.5 ha. No historical and religious sites are there under the command area. Two protected areas are situated: (i) Aural Wildlife Sanctuary and (ii) Tonle Sap Multiple Use Area in the Basin where sub-project is located. As for drinking and domestic water, farmers are largely dependant on dug well. Since existing irrigation facilities are significantly deteriorated and no permanent headworks are equipped, irrigation water is not provided from the system. Instead, farmers are largely dependent on rainfall and flood water especially in the wet season.

Stakeholder Opinions

06. During the field survey, the Study Team visited PDOWRAM, PDOE, and PDA to receive useful information for the sub-project. Workshop and public meeting shows that social environmental issues rather need to be considered. At present, cultivation and fish pond operation is carried out by farmers in the Boueng Khnar River and canal areas where it is stipulated as state property areas. Although farmers have really understood that such activities are drawn up before commencement of the construction works according to the discussion in the workshop, proper steps and mitigation measures are required for consensus building among relevant institutions and farmers.

Result of IEIA

07. Sub-project components consist of: (i) rehabilitation of irrigation and drainage facilities, (ii) FWUC establishment and strengthening and (iii) agriculture support. Main subjects of FWUC establishment and strengthening and agriculture support are: (i) awareness program, (ii) module development, (iii) training and (iv) small-scale pilot exercise in agriculture and irrigation rehabilitation, therefore, adverse potential impact toward environment in and around the sub-project area is completely none or negligible or small. Thus activities (ii) and (iii) are screened out from IEIA. IEIA in this report concentrates on potential impact from the rehabilitation of irrigation and drainage facilities. Potential negative environmental impacts are tabulated as follows:

Potential Negative Environmental Impact

Item		Stage		
		Preparation	Construction	O&M
Social Environment	Involuntary Resettlement	Land acquisition by the expansion and/or new construction of canals and drains (main, secondary and tertiary canals)	-	-
	Local Conflict Over Interest	-	Conflict among construction labors and farmers	Conflict over unequal water use within the sub-project command area and with other sub-projects (Damnak Ampil and Wat Loung)
	Water Use	-	Reduction of drinking, domestic and irrigation water by the Headworks construction in the River	-
	Sanitation	-	Due to inflow of labors from outside	-
	Risk against Infectious Diseases	-	Due to inflow of labors from outside	-
Natural Environment	Coastal area such as Mangrove, Coral Reef and Tidal Area	-	-	Increase in chemicals and fertilizers application
	Flora, Fauna and Biodiversity	-	Disturbance of fish sprawling by construction works	Disturbance of fish sprawling by construction works
Pollution	Air Pollution	-	Dust and emission gas from construction works	-
	Water Pollution	-	Waste water	Acceleration of

Item		Stage		
		Preparation	Construction	O&M
			increase from construction works	nutrient load and/or chemical contamination in drainage water due to increase in chemicals and fertilizers application
	Soil Contamination	-	-	Misuse and/or excessive usage of chemicals and fertilizers
	Waste	-	Improper disposal of waste from construction works	-
	Noise and vibration	-	Due to construction machinery	-
	Accidents	-	Due to construction machinery	-

Environmental Management Plan

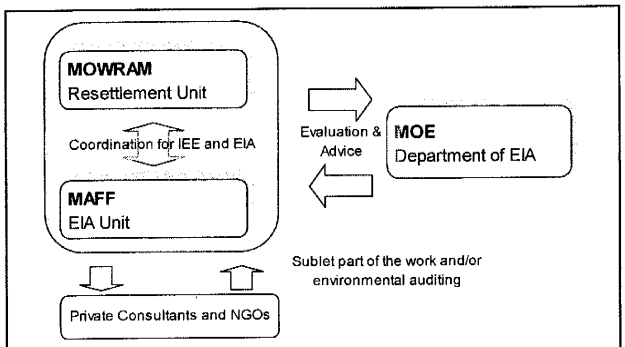
08. Corresponding to the negative impact identified through IEIA, seven mitigation measures are proposed as follows: (i) participatory land acquisition planning for main and secondary level facilities, (ii) participatory tertiary development for tertiary level facilities, (iii) education program for construction labor, (iv) construction of fish ladder, (v) environmental consideration in technical specification for construction works, (vi) System O&M and water management improvement and (vii) appropriate application of agricultural input, all of which are effective measures to alleviate environmental impact from the sub-project implementation. Among others, land acquisition is an important and a sensitive matter for irrigation project and the Lum Hach sub-project is not left out. It is recommended that mitigation measures be carried out as proposed so as to ensure sub-project sustainability from social environmental point of view.

Comparison between "With" and "Without" conditions

09. Comparison of conditions between "With" and "Without" conditions of the sub-project is made. Without implementing the Lum Hach sub-project, the livelihood of the people will most likely continue at their present levels. Each time the fertility of the plot of land comes to unproductive levels excessive intensity of production if future population pressure is considered. The implementation of the sub-project will mitigate the present instability in farming by providing irrigation water through rehabilitated facilities. It will make way for farming in more stabilized manner, improve living standards and provide additional income. It will gradually bring about a balance in resource use and reduce land degradation. Producing sufficient rice for domestic consumption is a priority policy of the government of Cambodia. Food security will be improved through increasing rice production which is one of the more important objectives of the sub-project.

Institutional Development Plan

10. In order to properly carry out EIA, prepare environmental management plan and pursue its implementation for irrigation development in the future, coordination is required between the Resettlement Unit under MOWRAM and EIA unit of MAFF. In addition, out-sourcing of the part of EIA work to private consulting firm should be also considered. Training programs proposed for environmental management is: (i) On-the-Job Training for IEIA and Preparation of TOR for EIA and (ii) Training for Environmental Impact Mitigation and Management Planning.



Conceptual Framework for IEIA/EIA Organization

Conclusion

11. It is concluded that the project will be extremely beneficial to the communities living in the sub-project areas. There will be better productivity and an improved livelihood if the project recommendations were to be implemented. No serious adverse environmental impacts are predicted since the sub-project is existing one and no large scale of expansion and/or new development is included. Those environmental impact identified are of a minor nature. Mitigation and enhancement measures are suggested where necessary and these will bring about an overall improvement in environmental quality. Indeed, once completed, well managed sub-project should enhance the long-term sustainability of the rural environment. In view of the above conclusions arising out of the IEIA of the sub-projects, a full scale EIA is not considered necessary.

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MINISTRY OF WATER RESOURCES AND METEOROLOGY
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BASIN-WIDE BASIC IRRIGATION AND DRAINAGE MASTER PLAN

Sub-Project Layout
Summary

Table of Contents

List of Tables

List of Figures

List of Boxes

Abbreviations

ACLEDA	Association of Cambodian Local Economic Development Agencies
ADB	Asian Development Bank
AEA	Agro-Ecosystems Analysis
AEO	Agricultural Extension Offices
AEWs	Agricultural Extension Workers
ASEAN	Association of South East Asian Nations
B/C	Benefit-Cost Ratio
CARDI	Cambodian Agricultural Research and Development Institute
CC	Commune Council
CCF	Construction Conversion Factor
CDRI	Cambodia Development Research Institute
CDC	Council for Development of Cambodia
CEA	Cambodian Environment Association
CEC	Cation Exchange Capacity
CEDAC	Centre d'Etude de Development Agricole Cambodgien
CMAC	Cambodia Mine Action Center
CNMC	Cambodian National Mekong Committee
DAFF	Department of Agriculture, Forestry and Fisheries, MAFF
DAE	Department of Agriculture Extension
DAO	District Agricultural Office
DHRW	Department of Hydrology and River Works
ED	Engineering Department, MOWRAM
EDC	Electricite du Cambodia
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EU	European Union
EXCOM	Executing Committee of SEILA
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmer Field School
FG	Farmers Group
FO	Farmer Organization

F/S	Feasibility Study
FWUC	Farmer Water User Community
FWUG	Farmer Water User Group
GDP	Gross Domestic Product
GIS	Geographic Information System
GOC	Government of Cambodia
GOJ	Government of Japan
HH	Household
IEE	Initial Environmental Examination
IEAD	International Fund for Agricultural Development
IEIA	Initial Environmental Impact Assessment
IFAD	International Fund for Agricultural Development
ILO	International Labor Organization
IMF	International Monetary Fund
IMT	Irrigation Management Transfer
IO	International Organization
IPM	Integrated Pest Management
IRC	Inter-Ministerial Resettlement Committee
ISF	Irrigation Service Fee
JICA	Japan International Cooperation Agency
MAFF	Ministry of Agriculture, Forestry and Fisheries
M & E	Monitoring and Evaluation
MIS	Market Information System
MLMUPC	Ministry of Land Management, Urban Planning and Construction
MOE	Ministry of Environment
MOI	Ministry of Interior
MOWRAM	Ministry of Water Resources and Meteorology
M/P	Master Plan Study
MRC	Mekong River Commission
MRD	Ministry of Rural Development
NCCD	National Coordination Committee for Decentralization
NPRS	National Poverty Reduction Strategy
NGO	Non Government Organization
NEC	National Election Committee
O & M	Operation and Maintenance
PDA	Provincial Department of Agriculture
PDE	Provincial Department of Environment
PDLMUPC	Provincial Department of Land Management, Urban Planning and Construction
PDOWRAM	Provincial Department of Water Resources and Meteorology, MOWRAM
PIF	Provincial Investment Fund
PIMD	Participatory Irrigation Management and Development
PO	Project Owner
PRDC	Provincial Rural Development Committee
PRASAC II	Support Program for the Agricultural Sector in Cambodia
PSDD	Project to Support Democratic Development through Decentralization and Deconcentration
PMG	Project Management Group
RGC	Royal Government of Cambodia
RIP	Rural Road Improvement Program
RRA	Rapid Rural Appraisal

SEILA	Foundation Stone in Khmer: This word is used as national rural development program to 1- alleviate poverty and 2- Strengthen local governance and ownership of local government. (The Program ended in 2007)
SLPP	Smallholder Livestock Production Program
SPFS	Special Program for Food Security
SRI	System of Rice Intensification
TOT	Training of Trainers
UN	United Nations
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
UNTAC	United Nations Transitional Authority in Cambodia
UXO	Unexploded Ordnance
VAHW	Village Animal Health Worker Associations
VDC	Village Development Committee
VEW	Village Extension Worker
VLA	Village Livestock Agent
WFP	World Food Program
WMO	World Meteorological Organization
WUG	Water User Group
DOM	Department of Meteorology
DHRW	Department of Hydrology and River Works
TSC	Technical Service Center
PDOWRAM	Provincial Department of Water Resources and Meteorology
MRC	Mekong River Commission

Khmer Words Used in the Report

Khet	Province
Srok	District
Khum	Commune
Phum	Village
Krom	Group or Sub-Group
Krom Samik	Solidarity Group
Provasdai	Mutual Help

INITIAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT
LUM HACH REHABILITATION SUB-PROJECT

CHAPTER 1 INTRODUCTION

1.1 General

This is an Initial Environmental Impact Assessment (IEIA) Report of Lum Hach Rehabilitation Sub-Project prepared on the basis environmental assessment-related regulations, sub-decree and guidelines of Cambodia. The Report describes the environmental assessment system in Cambodia, the present environmental condition, result of the environmental assessment, and environmental management plan of Lum Hach Sub-Project. Field reconnaissance was carried out to grasp the natural and social condition of the site.

It shall be noted that in this Pre-Feasibility Study, an emphasis has been given to minimize the probable adverse environmental impacts from natural and social view points in the course of the plan formulation process. In this Report, Chapter 1 describes environmental impact assessment system in Cambodia including environmental laws and regulations, which are the basis of all the environmental assessment under this Report. Project screening is also mentioned in the Chapter. Chapter 2 is the methodology of environmental study applied. From Chapter 3 to Chapter 5, outline of proposed sub-project together with environmental conditions and stakeholders' opinion is delineated.

On the basis of proposed project component, an IEIA is carried out as described in Chapter 6. Chapter 7 shows mitigation measures and environmental monitoring plan corresponding to the impacts identified in the previous chapter. Chapter 8 covers comparison between "with-project-condition" and "without-project-condition" from natural and social aspects. In order to establish workable environmental monitoring and evaluation set-up, institutional development plan is prepared in Chapter 9 so as to contribute to sustainable irrigation development in Lum Hach Irrigation Sub-Project. Chapter 10 finally provides overall conclusions of IEIA.

1.2 Environmental Impact Assessment System

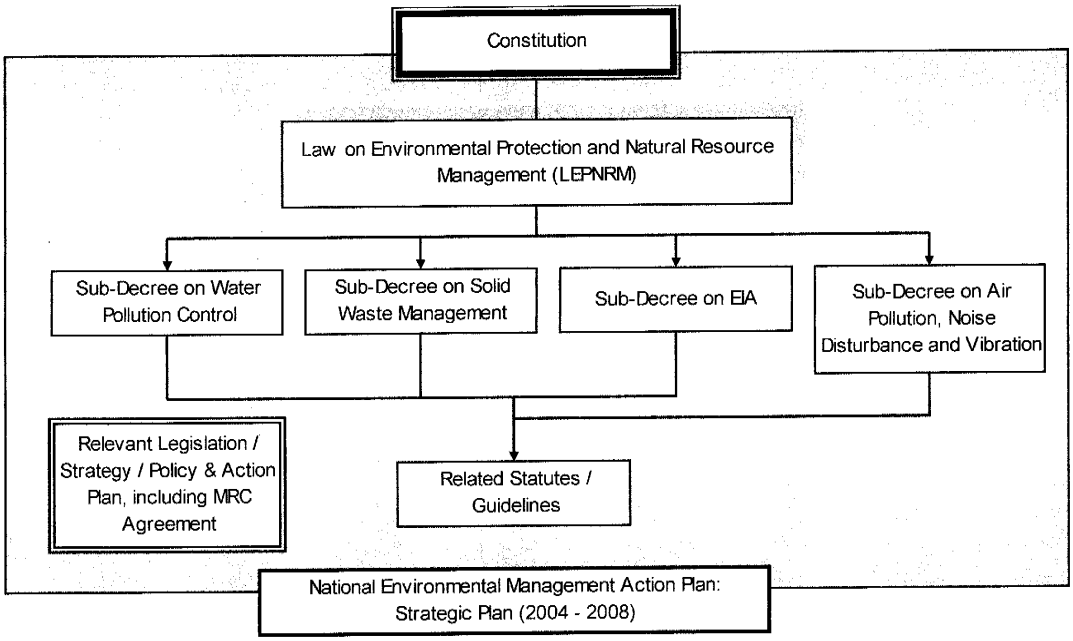
1.2.1 Environment Related Laws and Regulations

(1) List of Laws and Regulations

In the 1990s, the Government of Cambodia enacted several key pieces of environment related laws and regulations to establish the legal framework of environmental management. The Ministry of Environment (MOE), established in 1993, is the key agency responsible for environmental management and natural resource conservation. MOE's strategy is on the basis on the execution of both sole and joint responsibilities since environmental management is interdisciplinary and cross-sectoral issues requiring close inter-coordination. MOWRAM and

MAFF also have been playing an important role in environmental management related with irrigated agriculture development in collaboration with MOE.

Relevant laws and regulations with those provisions are summarized as follows:



Prepared by JICA Study Team

Legislative Framework in Environmental Protection and Management

(i) Law on Environmental Protection and Natural Resource Management and Sub-Decrees

Under the Constitution, Law on Environmental Protection and Natural Resource Management (LEPNRM) was enacted in 1996, which is the supreme legal instrument controlling environmental protection and natural resource management in the country. The salient feature of LEPNRM is: (i) to protect and promote environmental quality and public health, (ii) to assess the environmental impact of all proposed projects, (iii) to encourage and enable the public to participate in environmental protection, and natural resource management and (iv) to suppress any act that cause harm to the environment. In order to ensure the contents of LEPNRM and supplement for environmental management in practice, four Sub-Decrees have been issued: (i) Sub-Decree on Environmental Impact Assessment Process (1999), (ii) Sub-Decree on Water Pollution Control (1999), (iii) Sub-Decree on Solid Waste Management (1999) and (iv) Sub-Decree on Air Pollution and Noise Disturbance (2000).

(ii) Environment-related Policies and Plans

In terms of environmental management policy, MOE together with line-agencies has prepared National Environmental Action Plan (NEAP) and has been regularly updating Strategic Plan based on the above-explained set of laws and decrees, summary of which are tabulated as follows:

Relevant Environmental Management Policy and Plans

Title	Contents
National Environmental Action Plan	It was firstly prepared by MOE in 1998 with the assistance from World Bank, UNDP, USAID and DANIDA and approved by the Council of Ministries in 1998. It aimed at integrating environmental concerns into national and local development polices, economic decisions making, and investment planning particularly focusing on forest policy, fisheries and floodplain agriculture in Tonle Samp Region, costal fisheries and so forth.
The Five Year Socio-Economic Development Plan (1996-2000)	It emphasized on conservation, protection and management of country's natural resources and environment in an ecologically sustainable manner outlining long-term management strategies for forest and protected areas, coastal zone, Tonle Sap Great Lake ecosystem, fisheries, water quality, and urban and community environment improvements.
The Second Five Year Socio-Economic Development Plan (2001-2005)	It focuses on social and economic development in rural areas, basic human needs, and poverty alleviation. The plan emphasizes on implementation of natural resource preservation and environmental protection programs particularly in rural areas.
Land Policy 2001	The objective is to ensure that land and natural resources are used in an equitable, sustainable and efficient manner. The Government has set a number of medium term objectives including forest concession management, reduction in urban and industrial pollution, strengthening protected area management, improving management of Tonle Sap ecosystems, and building the environment planning capacity.
Strategic Plan	The First Three-Year Strategic Plan (1998 -2000) It was prepared by reviewing all sectors activities including economy, society, culture, infrastructures, and environmental protection. Socio-development was started to be focused which gives adverse impact in environment. The Second Three-Year Strategic Plan (2001 – 2003) Awareness on environmental protection was getting to be matured with the understanding that environmental management is consecutive action based on previous lessons. Importance on MOEs' capacity development was also emphasized for sustainable development in any sectors. The Third Five-Year Strategic Plan (2004 – 2008) The latest plan prepared in 2003 emphasizes following issues: (i) inter-sectoral coordination within MOE as well as other Ministries, and (ii) public participation in environmental management.

Source: Asian Development Bank (ADB) (2003), Compendium on Environment Statistics 2003 Cambodia
Ministry of Environment (MOE) (2003), Strategic Plan 2004 – 2008

(iii) Development Activities in the Protected Areas

Declaration No. 1033 on Protected Areas (1994) prohibits the following activities in order to conserve those areas:

- Construction of the saw mills, charcoal ovens, brick kilns, tile kilns, limestone ovens, tobacco ovens (Article 1)
- hunt or the placement of hunting traps, the fishing of mammals, amphibians, reptiles and aquatic animals for tusks, bones, feathers, horns, leathers and blood (Article 2)
- Deforestation for land use (Article 3)
- Exploitation of minerals and the use of explosives (Articles 4)
- Bringing of the domestic animals such as dogs (Article 5)

- Water pollution activities such as the use of explosives, poisons, chemicals, electricity and dumping waste into the water surface or onto the land (Article 6)
- Use of machineries and heavy cars which could cause smoke pollution, and use of microphones which could cause noise pollution (Articles 7)

The Article 8 of the Declaration stipulated that ***researchers and experiments in protected areas shall be approved by the Ministry of Environment***. Although there are no irrigation systems to be developed in the protected areas, monitoring particularly water quality in the downstream of the system would be required to give adverse environmental impact toward protected areas.

(3) Land Policy and Legal Framework

(i) Land Law

The new Land Law, passed in August 2001, incorporates a number of significant changes and enhancement from previous Land Law 1992. The new Law consists of eight articles shown on the right:

Land Law 2001

General Provisions	
Article 1	Private and Public Ownership
Article 2	Acquisition of Ownership
Article 3	The Regime of Private Ownership
Article 4	The Forms of Ownership
Article 5	Immovable Property Used as Surety
Article 6	Cadastre
Article 7	Penalty Provisions
Articles 8	Final Provisions

Source: MLMUPC (2002)

The Law deals with ownership, property rights and compensation which are needs to be considered for irrigation and drainage development. According to the law, state properties are defined as such facilities as social infrastructures involving its land and natural origins, forest, rivers, protected areas and so forth.

This issue can be also supplemented by the Law on Water Resources Management that the beds and banks of rivers, streams, lakes, canals, and reservoirs are owned by the State.

(ii) Land Tenure and Land Registration

Land tenure and registration is not clear at present including agriculture sector. Land distribution particularly in rural areas has been carried out through the *Krom Samiki* (Solidarity Group under community) system. While lands were allocated and private ownership of plots recognized, no clear demarcation was officially made. Since new Land Law 2001 enacted, Ministry of land Management, Urban Planning and Construction (MLMUPC) is the sole institution in charge of land registration, however, understanding in the rural level is still in challenging and customary land tenure is in majority.

(iii) Resettlement Policy

There are no stipulated official documents at present, however, in the irrigation sector, it used to be not compulsory for the Government to compensate farmers land for tertiary development while compensation is supposed to be made to farmers for main and secondary facilities development in irrigation systems with the responsibility of Inter-Ministerial Resettlement Committee (IRC). Resettlement Unit under MOWRAM is currently drafting sub-decree and

guideline on the basis of ADB resettlement policy in order for smooth consensus building and resettlement among stakeholders as shown right.

ADB policy in resettlement[1] emphasized, on the other hand, following points:

- People affected should be at least as well off after resettlement as they were before;
- Social preparation is an important process for reducing tension and obtaining cooperation;
- People affected temporarily are counted and must be compensated and assisted accordingly; and
- All affected persons, including those without title to land, must be compensated for all their losses at replacement cost.

Until now in Cambodia, resettlement matter in irrigation and drainage development is generally dealt with by each project in accordance with the donors' policy and guidelines such as ADB's.

Sub-Decree on Addressing Socio-Economic Impacts caused by Development Projects

Chapter 1	General Provisions
Chapter 2	General Public Interest and National Interest
Chapter 3	General Principles and Requirements
Chapter 4	Procedure for Determining Specific Nature of a Proposed Project
Chapter 5	Planning to Address Project Social Impacts
Chapter 6	Compensation and Rehabilitation Assistance
Chapter 7	Complaints and Judicial Review
Chapter 8	Budget
Chapter 9	Institutional Arrangements
Chapter 10	Final Provisions

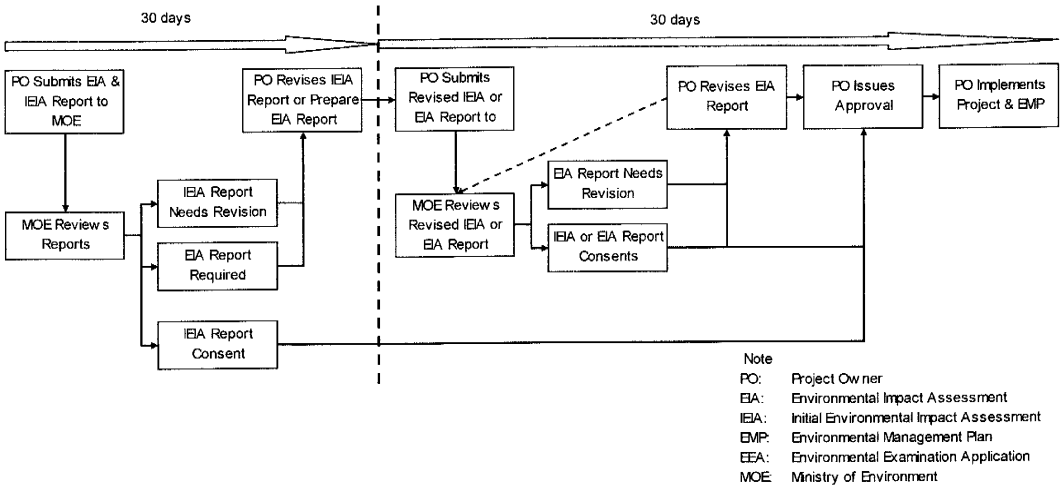
Source: MOWRAM (2007)

(4) Process of Environmental Impact Assessment

Procedure of EIA is stipulated in the Sub-decree on Environmental Impact Assessment Process enacted in 1999. The decree deals with institutional responsibilities, environmental impact assessment requirements necessary for proposed projects, EIA process for different type of projects and penalties. In addition, list of project with its scale is defined necessary for IEIA or EIA. Within MOE, Departmnet of EIA under Technical General is responsible for the review and the assessment of IEIA and EIA report submitted from Project Owners (POs).

IEIA and EIA process are depicted below, description of which is given afterward:

[1] Asian Development Bank (ADB) (1998), Summary of the Handbook on Resettlement, A Guide to Good Practice



(1) Project Owner (PO) firstly prepare Initial Environmental Impact Assessment (IEIA) reports based on assessment of existing environmental conditions and identification of environmental impact and its magnitude to be borne by project implementation. PO submits the report to MOE together with an Environmental Examination Application (EEA) and Pre-Feasibility Report.

(2) MOE reviews reports whether it is acceptable to comply with the Sub-Decree or the project needs full-scale of EIA. The result of review is informed to PO within 30 days after submittal of the reports.

(3) The PO revises and/or prepares report based on the instruction from MOE and submission again.

(4) MOE examines the IEIA or EIA report and notify the PO comments, if any, within another 30 days after 2nd submittal. The PO then can receive the approval from MOE for project implementation after all the revision of the report is made.

Source: Sub-Decree on Environmental Impact Assessment Process

Procedure of Environmental Impact Assessment

In addition, format of EIA report is instructed by the Guideline for Conducting Environmental Impact Assessment Report (2000).

Agriculture projects necessary for IEIA or EIA is clearly defined in the Sub-Decree, which is tabulated as follows:

Agriculture Related Projects Requiring an IEIA or an EIA

Type and Activities of Projects		Size / Capacity
1. Agriculture		
(i)	Concession forest	≧10,000 ha
(ii)	Logging	≧500 ha
(iii)	Land covered by forest	≧500 ha
(iv)	Agricultural and agro-industrial land	≧10,000 ha
(v)	Flooded and coastal forests	All sizes
(vi)	Irrigation systems	≧5,000 ha
(vii)	Drainage systems	≧5,000 ha
(viii)	Fishing ports	All sizes
2. Projects Related to Agriculture		
(i)	Food processing and canned goods	≧500 ton/year
(ii)	All fruit drinking manufacturing	≧1,500 liters/day
(iii)	Fruit manufacturing	≧500 ton/year

	Type and Activities of Projects	Size / Capacity
(iv)	Orange juice manufacturing	All sizes
(v)	Sugar refinery	≧3,000 ton/year
(vi)	Rice mills and cereal grains	≧3,000 ton/year
(vii)	Chemical fertilizer plants	≧10,000 ton/year
(viii)	Pesticide industry	All sizes
(xi)	Animals food processing	≧10,000 ton/year

Source: Annex of Sub-Decree on Environment Impact Assessment Process

In the irrigation sector, it is stated that an IEIA or EIA is required for the projects with more than 5,000 ha.

As decentralization process is being applied at Provincial level also within the administration of environmental management, EIA process is not left out. In the case of projects with the cost of less than US$ 2 million, Provincial Environmental Department (DOE) is responsible for EIA approval while others with the cost of more than US$ 2 million must be reviewed and approved by MOE Central.[2]

(5) Pollution Standard Related with Irrigation

In this section, pollution standard is explained based on Cambodian regulatory framework. In related with irrigation sector, management of "water quality" and "noise," latter of which is particularly during construction phase of the project, are focused.

(i) Water Quality

Water quality management is stipulated in Sub-Decree on Water Pollution Control issued in 1999. It consists of effluent discharge permit, monitoring of the pollution sources, procedures and penalty. In the irrigation sector, water quality for river, lakes and reservoir are the high concerns; standard of which shown in the Sub-Decree is as tabulated below:

Water Quality Standard in Public Water bodies for Bio-Diversity Conservation

No	Parameters	Unit	Standard Value
Rivers			
1	pH		6.5 - 8.5
2	BOD	Mg/l	1 – 10
3	Suspended Solids	Mg/l	25 – 100
4	Dissolved Oxygen	Mg/l	2.0 – 7.5
5	Coliform	MPN/100ml	< 5,000
Lakes and Reservoirs			
1	pH		6.5 – 8.5
2	COD	Mg/l	1 – 8
3	Suspended Solids	Mg/l	1 – 15
4	Dissolved Oxygen	Mg/l	2.0 – 7.5
5	Coliform	MPN/100ml	< 1,000
6	Total Nitrogen	Mg/l	0.1 – 0.6
7	Total Phosphorus	Mg/l	0.005 – 0.05

Source; Annex 4 of Sub-decree on Water Pollution Control

Although standard is prepared, monitoring station establishment is still in progress. There is

[2] Under decentralized mechanism, MOE also focus on devolving to DOE environmental monitoring through technical support and capacity development of DOE as well.

only one water quality monitoring station under MOWRAM, located in Battambang Province. No monitoring is carried out in the Boribo River Basin

(ii) Noise Pollution

Noise pollution standard, which is closely related with irrigation works particularly during construction, is defined in Sub-Decree on Air and Noise Pollution Control enacted in 1998. The maximum permitted level of noise at different locational conditions is as tabulated below:

Maximum Permitted Noise Level in Public and Residential Areas (dB(A))

No	Area	Period of time		
		From 6 am To 6 pm	From 6 pm To 10 pm	From 10 pm To 6 am
1	Quiet Areas, Hospitals, Libraries, Schools, Kindergartens	45	40	35
2	Residential Area, Hotels, Administration offices, Houses	60	50	45
3	Commercial and service area and mix	70	65	50
4	Small industrial factories, intermingling in residential areas	75	70	50

Source; Annex 6 of Sub decree on air and noise pollution

1.3 Screening of the Sub-Projects

IEIA is carried out for the Lum Hach Rehabilitation Sub-Project although its command area extends to only 3,100 ha, less than prescript area, 5,000 ha, in the Sub-Decree on EIA process. The sub-project only consists of rehabilitation of existing irrigation systems with no new land development. All the fields are currently cultivated with paddy and partially upland crops. Therefore, its adverse potential environmental impacts on human population or environmentally protected and/or important areas are judged less, which are site-specific and few are irreversible.

Under the Study, therefore, only IEIA is carried out as part of Pre-F/S to confirm potential positive and negative environmental impact to be expected from the Sub-Project, requirement for which is also stipulated in the guideline issued by Japan International Cooperation Agency (JICA). And environmental management plan is prepared so as to ensure sustainability of the sub-project from environmental point of view.

CHAPTER 2 PROCEDURE OF THE ENVIRONMENTAL STUDY

An Initial Environmental Impact Assessment has been carried out for the Sub-Project on the basis of the sub-decree and guidelines as explained in Chapter 1. The survey was through both qualitative and quantitative manners by means of interview survey, field reconnaissance and preliminary measurement.

2.1 Stakeholder Consultation

Stakeholder consultation was carried out through two methodology: (i) Interview Survey and (ii) Workshop and/or Public Meeting as described as follows:

Public Meeting at the sub-project (January 28th, 2008)

(1) Interview Survey

An interview survey was carried out to confirm socio-economic conditions, agriculture practice, and irrigation O&M and water management and to extract opinions of stakeholders as follows:

Contents of Questionnaire	
Part 1	**Socio-Economy**
Section I	General information about socio-economy
Section II	Living condition
Section III	Income and expenditure
Section IV	Savings and loan
Part 2	**Agriculture**
Section I	Livestock and fruits trees
Section II	Land holding
Section III	Cropped area & production (crop year 2005/2006)
Section IV	Farming practices (practices adopted by interviewee in the last year)
Section V	Production (crop year 2005/2006)
Section VI	Post-harvest, processing and marketing
Section VII	Agricultural support services
Section VIII	Farming constraints and improvement
Section IX	Livestock Constraints
Section X	Expectation
Section XI	Participation in agricultural support/project activities in the past
Part 3	**Irrigation/Drainage & Water Management**
Section I	Participatory awareness level for the project
Section II	Negative effect
Section III	Irrigation, water management & farmers water users community (FWUC)
Section IV	Flood damage
Part 4	**Crop Budget**
Wet Season Rice Cultivation	
Dry Season Rice Cultivation	

(2) Environmental Discussion in the Workshop

Environmental conditions and constraints are confirmed and discussed among stakeholders through questionnaire in the qualitative manner, which would be effective for qualitative assessment of environmental conditions in the sub-project area as well as enhancement of understanding toward environment among stakeholders. The issues discussed are listed as

follows:

- ***Natural Environment***: deforestation, water quality problem, water contamination, groundwater contamination, soil erosion, water logging, salinity problem, water-borne disease, soil contamination, and salinity problem
- ***Irrigation Water Supply***: frequency of irrigation water
- ***Social Environment***: conflict of water right with other system, conflict of water distribution within the sub-project, conflict of land allocation, illegal cropping, and flood damage
- ***Others***: historical/cultural heritage, protected/conserved area, endangered species, precious ecology, environmental management activities, member of FWUC, and interested in FWUC

2.2 Field Reconnaissance

Field reconnaissance was conducted to confirm natural and ecological environment of the sub-project area. Current condition of O&M and water management of irrigation system was also surveyed so as to prepare improvement plan from the view point of social environment.

Quantitative water quality analysis was carried out for preliminary basis using water quality analysis equipment to supplement water quality data currently being collected by MOWRAM.

CHAPTER 3 SUB-PROJECT BRIEF

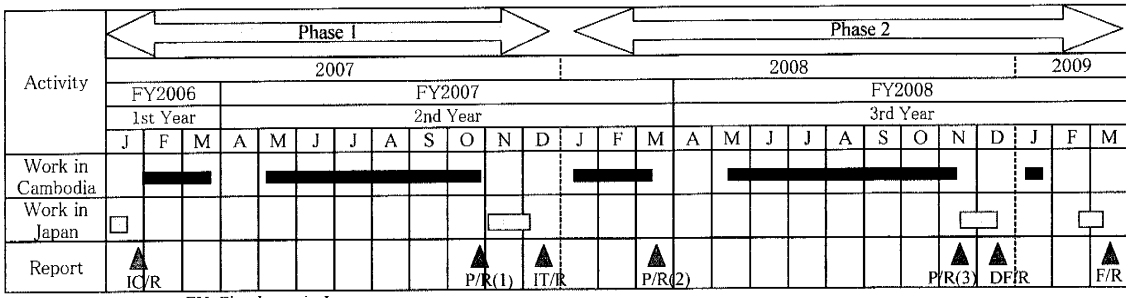
3.1 Background and Justification of the Sub-Project

The Lake Tonle Sap and its catchment area have been playing an important role for poverty alleviation as well as economic growth in Cambodia. The main economic activity in the region is agriculture by producing rice as a main crop. Most of the irrigation systems in this region was constructed between 1975 and 1979 during Pol Pot Regime. At present, they are significantly deteriorated, therefore, actual irrigation rate remains only 10 %. Revitalization of those irrigation systems is of critical importance in order to enhance country's food security.

On the basis of such background, the Royal Government of Cambodia (RGC) requested the Government of Japan (GOJ) to carry out technical assistance for the Basin-wide Basic Irrigation and Drainage Master Plan Study in the selected four river basins. In response to this request, the GOJ dispatched a preparatory study team in May 2005 to select river basins for the Study: Battambang, Moung Russey, Pursat and Boribo. The GOJ in succession dispatched the Mission for the Scope of Work (S/W) in August 2006 to discuss and finally agree the S/W for the Study with the RGC.

The full Study has been being carried out since January 2007 until February 2009 as the schedule illustrated as follows:

Schedule of the Study



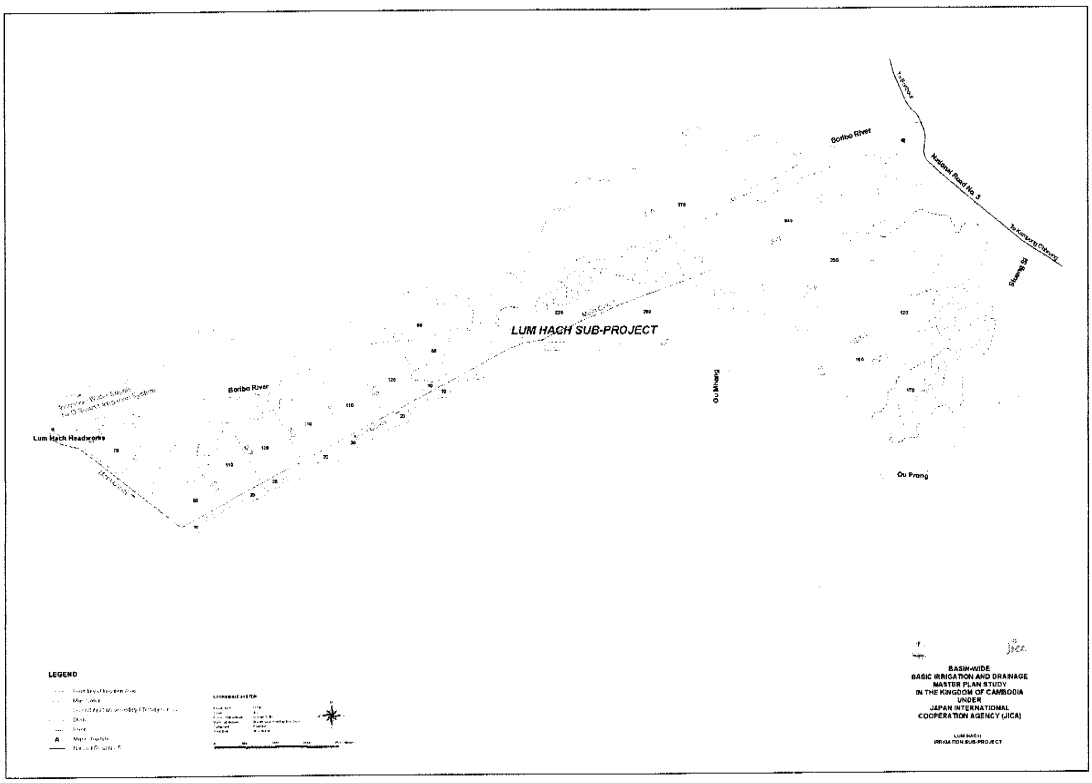
FY: Fiscal year in Japan

In the course of the Study, Lum Hach Rehabilitation Sub-Project was selected as one of the priority projects in the Boribo River Basin from the view point of comprehensive set of criteria: (i) resource factor, (ii) economic factor, (iii) social factor, (iv) environmental factor, (v) ease of implementation, and (vi) maturity factor. As evident, implementation of Lum Hach sub-project is expected to contribute to the enhancement of food security in Cambodia through technically appropriate, economically sound, sociologically suitable and environmentally friendly ways.

3.2 Type, Size and Location of the Sub-Project

The sub-project aims to revitalize irrigated agriculture primarily by: (i) the rehabilitation of irrigation facilities, (ii) FWUC establishment and strengthening and (iii) agricultural and other support.

Item	Description		
1.1 Location	District	Commune	Village
	Boribo, RoLeaPha-ea	AnChagnRoung, PonLey, PoPel, ProSneb, and other 7 communes	TaingPrich, Prosneb, TaingThneum, Kdol, and other 27 villages
1.2 River basin/ water source	Boribo river basin/ Boribo river		
1.3 Target group	1) Number of household = 2,066 (Wet season medium- paddy) 2) Staff of PDOWRAM and PDA		
1.4 Objective of the project or program	1) Enhancement of rice production through rehabilitation of Lum Hach Headworks and existing irrigation system		
1.5 Type of project or program	1) Rehabilitation of existing irrigation system		
1.6 Objective area	3,100 Ha		
1.7 Necessity of project/program	Water source for irrigation is limited in the Boribo basin. The Boribo, the largest river in the basin, originates from the Lum Hach headworks. Since the reservoir has no structure to control water, water resources cannot be effectively utilized. In order to stabilize irrigation water supply, it is of importance to construct and/or rehabilitated water control facilities on Boribo River. In addition, rehabilitation of existing irrigation and drainage systems would be also another key issue to increase irrigated agriculture area.		



Prepared by JICA Study Team

General Layout of Lum Hach Rehabilitation Sub-Project

The Lum Hach Rehabilitation Sub-Project is located in Boribo District in Kampong Chhnang Provice. Command area spread to 3,100 ha in total. Lum Hach Headworks is proposed to be constructed on Boribo River so as to regulate water for irrigation in the command area. Irrigation and drainage facilities will be also rehabilitated to stably deliver the water.

3.3. Sub-Project Component

Component of the Lum Hach Sub-project is tabulated as follows:

Irrigation and Drainage Rehabilitation Plan for Lum Hach Rehabilitation Sub-Project

No.	Description	Area and/or Number
1.	Sub-project area (Ha)	3,100
	(Pump irrigation area included above)	(410)
2.	Annual irrigation area (Ha)	4,700
	- Early wet season paddy (Ha)	1,300
	- Medium wet season paddy (Ha)	3,100
	- Dry season paddy (Ha)	300
3.	Major water source	Boribo River
	- Name of headworks	Lum Hach (Reconstruction)
	- Intake water level (EL. m)	38.00 - 36.00
	- Diversion water requirement at intake (m3/sec)	6.60
4.	Main canals (nos.)	1
	- Total length (km)	16.4
	- Capacity (m3/sec)	1.98 – 6.60
5.	Nos. of secondary canals	11
	- Total length (km)	42.4
	- Capacity (m3/sec)	0.23 – 1.15
6.	Number of Tertiary Blocks (No.)	67
	Total length of tertiary canals (km)	67
7.	Main drains	Boribo River
	- Total length (km)	-
	- Capacity (m3/sec)	Natural Stream
	- Drainage water requirement from paddy field (lit/sec/ha)	6.83
	- Drainage water requirement from other land (lit/sec/ha)	0.025~0.019
8.	Secondary drains (nos.)	11
	- Total length of secondary drains (km)	53.9
	- Capacity (m3/sec)	1.19 – 3.96
9.	Collector drains (nos.)	0
	- Total length of collector drain (New, km)	0
	- Capacity (m3/sec)	-

Prepared by JICA Study Team

Headworks and Major Facilities

Items	Description
-Lum Huch Diversion Weir Design Flood Discharge: Q=430m^3/s (T=100 years) Design Flood Water Level: WL. 38.0m Fish Ladder: B:5.0m x H:3.8m x L:38m	Floating type movable weir -width x height x length B:67m x H:10m x L:44m -Flood Gate: Fixed wheel gate B:15 m x H:4.0m x 3 nos. -Scouring Sluice Gate: Slide gate B:2m xH:3m x 2 nos.
- Lum Hach Intake Design Discharge: Q=6.60m^3/s	-width x height x length B:7.1m x H:3.8m x L:9.5m -Slide Gate: B:1.5m xH:1.5m x 3nos.
- O Roluss Intake Design Discharge: Q=5.70m^3/s	-width x height x length B:5.7m x H:4.8m x L:15m -Slide Gate: B:2.0m x H:1.5mx 2nos.
- Lum Hach Approach Canal Design Discharge: Q=6.60m^3/s (Max.30.0)	-width x height x length B:15m-23m x H:2.0m x L:750 m
- Closure Dyke for 7th January Canal	-width x height B:40m x H:2.4m

Prepared by JICA Study Team

CHAPTER 4 PRESENT ENVIRONMENTAL CONDITIONS OF THE SUB-PROJECT AREA

4.1 Physical Environment

4.1.1 River Basin

The Boribo River Basin extending 7,154 km^2, includes the Bomnak-Boribo-Tlea Maam river basin (1,422 km^2), the Svay Chek river basin, the Krang Ponley river basin and other small river basins. Main dimensions of the River Basin are shown as follows:

River Basin Dimensions

River Basin	Area	Lower area *1				> EL 30 *2		Highest Point*3
		EL 4-13		EL 14-30				
	(Km2)	(Km2)	(%)	(Km2)	(%)	(Km2)	(%)	(m, amsl)
Boribo	7,154	1,545	22	1,077	15	4,532	63	1,764
Total	22,868	6,289	28	3,183	14	13,396	58	1,764

Data source: 1/ MOWRAM and "Tonle Sap Lowland Stabilization Project, Report on Water Availability, Sep., 2006", financed by ADB; Original figure are rounded.
2/ The Study Team
3/ The Study Team from 1:100,000 scale topographic map
Prepared by JICA Study Team

4.1.2 Meteorology and Hydrology

(1) Meteorology

Climate of the Boribo River Basin is classified into tropical monsoon or savanna zone. Pochentong meteorological station is located beside the international airport in Phnom Penh near the southern perimeter of the Boribo River Basin.

Average Monthly Meteorological Values at Boribo River Basin

Boribo River Basin

Monthly		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature														
Mean	(°C)	26.3	27.9	29.4	30.3	30.1	29.4	28.8	28.7	28.2	27.5	26.7	25.9	28.2
Relative humidity	(%)	69	66	67	69	72	73	74	77	79	80	77	73	73
Wind velocity	(m/s)	2.0	2.3	2.4	2.2	2.3	2.5	2.2	2.7	2.3	1.6	2.1	2.1	2.2
Sunshine hours	(hr/day)	8.5	8.5	8.2	8.0	7.2	6.0	5.7	5.6	5.5	5.8	7.4	8.1	7.0
Evaporation	(mm/day)	4.1	5.1	5.4	5.3	4.5	4.4	3.7	3.8	3.2	3.1	3.4	3.6	4.1
	(mm)	127	142	167	158	140	130	115	115	94	96	101	111	1494

Note: Data = Average of Pochentong and Pursat Stations' data except sunshine hours
Sunshine hours = that of Pochentong Station * Wind velocity is adjusted to the equivalent one at 2 m height.

(2) Rainfall

In the plain of the Boribo River Basin, Kampong Chhnang Town receives the highest rainfall showing more than 1600 mm. Northern and southern parts of the Basin receive lower rainfall. Annual rainfall at the Lum Hach Sub-project is 1,600 mm.

(3) Mean monthly flow

The monthly specific discharges are estimated for the plain or the sub-basins of the Boribo River Basin. The results are shown as follows:

Mean Monthly Discharge of Boribo River Basin

from smaller rivers and streams	80 % Dependability											(lit/s/km2)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Boribo River Basin												
(g1,4,5) BMN-BOR: Bomnak Boribo	4.3	2.7	2.0	2.7	3.1	5.5	8.0	13.0	45.5	52.3	13.4	5.3
(g2,3) BMN-BOR: Bomnak Boribo	2.1	0.9	0.6	0.7	5.0	5.3	6.4	9.1	21.0	19.8	16.6	3.8
(h) BOR-N: Boribo North	2.1	0.9	0.6	0.7	5.0	5.3	6.4	9.1	21.0	19.8	16.6	3.8
(i) BOR-MN: Boribo Middle North	2.1	0.8	0.3	0.4	8.3	8.1	11.0	14.4	29.1	25.3	18.2	4.5
(j) BOR-MS: Boribo Middle South	2.4	0.9	0.4	0.1	3.7	4.6	7.6	11.9	26.7	20.8	15.5	4.1
(k) BOR-S: Boribo South	3.2	1.1	0.2	0.3	2.6	3.5	3.8	7.4	21.6	24.6	15.2	4.4

(4) Flood

Probable flood discharge is calculated as shown below. Since the available data is limited, return period of 5-year, 10 year and 20 year is calculated only.

Probable Flood Discharge

Unit: m3/s

Station	Return Period or Recurrence Interval					Data (Year)
	5	10	20	50	100	
Boribo River Basin						
Boribo	180	190	210			7

Note: Blank – not calculated due to short data period
Prepared by JICA Study Team

4.1.3 Soils

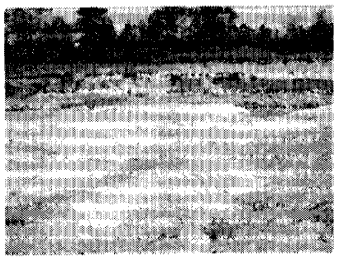
The soils distributed in the basin are classified at soil sub-unit level following the FAO/UNESCO classification system into 9 soil types (sub-units) as shown in Figure 4.1.1 and in the following table.

Soil Distribution in the Boribo River Basin

Soil Sub-unit	Distribution (ha)	Distribution (%)	Soil Sub-unit	Distribution (ha)	Distribution (%)
Gleyic Acrisol (ACg)	92,340	13	Luvic Arenosol (ARl)	680	-
Plinthic Acrisol (ACp)	23,270	3	ARl/ARh 2/	221,630	31
Areni-gleyic Acrisol (ACga)	1,560	-	Dystric Fluvisol (FLd)	40,650	6
Gleyic-plinthic Acrisol (ACpg)	10,630	1	Dystric Gleysol (GLd)	26,550	4
ACg/ACp 1/	119,750	17	LPd/CMd 3/	153,860	21
Haplic Acrisol-skeletic (Ach-C)	12,220	2	Water/Residential Area	12,260	2
			Total	715,400	100

1/: soil association of Gleyic Acrisol/ Plinthic Acrisol; 2/: association of Luvic Arenosol/Haplic Arenosol
3/: association of Dystric Leptosol/Dystric Cambisol
Prepared by JICA Study Team

The soil distribution in the basin is characterized by the extensive distribution of coarse textured soils in the central part of the same and 31% of the basin is covered with sandy soils. Among the sub-units, the association of Luvic Arenosol and Haplic Arenosol (ARl/ARh), sandy soil, is dominant soil followed by Gleyic Acrisol (ACg).



Significant Gully Erosion Observed in the Command Area Due to Erodible Sandy Soil (January 29th, 2008)

Luvic Arenosol/Haplic Arenosol (mapping symbol: ARl/ARh) is distributed extensively in the piedmonts to lowland areas in

the central part of the basin. Majority of lands distributed with this soil are covered by shrub or grass. While, part of the lands were developed as paddy fields and rice cultivation under transplanting system is prevailing practices in such fields. Both the soils have serious limitation for rice cultivation because of their coarse texture in the entire soil horizon.

4.1.4 Noise and Air Quality

There is no data related with noise and air quality in and around sub-project areas. It is conceivable that no serious noise pollution source exist in this area. In addition, as for air quality, only power generators of the private company and traffic particularly national road No. 5 and access to the command area, distance of which is 20 km from the national road to the command area, would give negative impact to some extent. Since the road condition in the command area is comparatively poor, traffic is observed inactive. Their impacts on noise and air quality in the command area are, therefore, not serious at present.

4.1.5 Water Quality

Water quality was preliminary assessed through field survey in the wet season, June 14th, 2008. The indicators analyzed are: (i) pH, (ii) Electric Conductivity (EC) and (iii) Total Dissolved Solid (TDS). The results are tabulated as follows:

Result of Water Quality Analysis

Name	Sampling Point	Date	pH	EC (µS/cm)	TDS (mg/l)	Remarks (Coordinate of sampling points, UTM)
Lum Hach Rehabilitation	Upstream of existing wooden check structure	14-Jun-08	7.2	29.6	14.6	N=1362388, E=0425211
	Mid-stream of main canal	14-Jun-08	6.9	32.5	16.0	N=1361879, E=0426460
	Downstream of main canal	14-Jun-08	6.2	25.1	12.3	N=1361197, E=0427397
Water Quality Standard	River		6.5-8.5	None (<70 µS/cm) Slight to Moderate (70-300 µS/cm) Severe (>300µS/cm)	<450	Standard for pH is given from Sub-Decree showing water quality for public water areas while that of EC and TDS is given from FAO specifically for irrigation purpose.

Note: Water quality standard is given form relevant document as follows:
pH: Ministry of Environment (1999), Sub-decree on Water Pollution Control
EC and TDS: FAO (1994), Water Quality for Agriculture, Irrigation and Drainage Paper 29
Prepared by JICA Study Team based on field sampling and analysis

According to the relevant guidelines: (i) MOE, Sub-Decree on Water Pollution Control and (ii) FAO, a point, existing intake weir site, shows lower level of pH than that in standard. These would be possibly given from water stagnation and inflow of effluent from surrounding areas including fish pond in the main canal areas.

On-site Water Quality Analysis
at Existing Main Canal
(June 14th, 2008)

4.2 Biological Environment

4.2.1 Vegetation and Land Use

The present land use of the sub-project area is paddy field under different irrigation statuses. Accordingly, the land use of the area has been classified based on current irrigation statuses into 2 sub-categories of : i) paddy fields with normal irrigation, ii) supplemental irrigation paddy field and iii) rainfed paddy field (including field under rainfed condition). Rainfed paddy field particularly in the wet season is the major land use in the Lum Hach sub-project command area.

4.2.2 Wild Life

Wildlife are rarely observed in and around the sub-project areas since the areas have been already cleared for agriculture particularly paddy cultivation. All the protected or conserved areas are located in the outside of sub-project areas. There are no detailed information, however, wild animals observed in and around the area include: (i) wild pig, (ii) rabbits, (iii) some spices of reptiles such as snakes and turtles in accordance with the field interview.

4.2.3 Protected Areas

Figure 4.2.1 shows protected areas of the Boribo River Basin where the Lum Hach sub-project is located. In Boribo River Basin, There are two protected areas: (i) Aural Wildlife Sanctuary and (ii) Tonle Sap Multiple Use Area, characteristics of which are tabulated as follows:

Protected Area in Boribo River Basin

Protected Area	Province	Total Area (ha) (Area in Basin, %)	Relevance with Basin Irrigation	Some Unique Characteristics
Aural Wildlife Sanctuary	Kampong Chhnang Province	253,750 (68,500, 27.0 %)	The upstream of irrigation systems in southern basin area	Highest mountain (1743m) in Cambodia with a wide diversity of vegetation ranging from dry Dipterocarpus / Podocarpus forest to medium altitude evergreen forest.
Tonle Sap Multiple Use Area	Kampong Chhnang Province	316,250 (12,600, 4.0 %)	The downstream of irrigation systems in northern part of basin	Long-standing ichthyological reserve. Great biological, hydrological and cultural/economic importance.

Prepared by JICA Study Team based on Ministry of Environment (2004), State of Environment Report

Aural Wildlife Sanctuary is located in the upstream of the sub-project, therefore, there would be no serious impact through irrigation development in the basin. On the other hand, Tonle

Samp Multiple Use Area is in the downstream of the Sub-Project. Increase of usage in fertilizer and pesticide generally seen through promoting irrigation development would possibly more or less affect water quality, if inappropriate and excessive application is carried out.

On the other hand, there are no protected areas or conserved area within the command area of Lum Hach Rehabilitation Sub-Project.

4.3 Social Environment

4.3.1 Population, Community and Ethnicity

The Sub-Project covers Boribo Districts in Kampong Chhnang Province primarily covering four communes: (i) Krang Skear, (ii) Anchanh Rung, (iii) Prasneb and (iv) Phsar. Total household under the command area approximately is 2,066 nos.

The community, in common with the religion in general, is Khmer and Buddhist, with no presence of ethnic minorities or immigrants of other nationalities under the sub-project area.

4.3.2 Education

Educational level of villagers are generally low as tabulated below, as most of farmers in the sub-project area have had only "no formal education" and/or "drop-out at primary school."

Education Career of Farmers

N=60

Career / Number & %	No Formal Education	Drop-out at primary school	Graduate from primary school	Drop-put at junior high school	Graduate from junior high school	Drop-out at high school	Graduate from high school	More than high school	Others
Number	8	39	7	2	2	1	0	1	0
Percentage	13.3%	65.0 %	11.7%	3.3%	3.3%	1.7%	-	1.7%	-

Prepared by JICA Study Team based on Interview Survey carried out during the Study

4.3.3 Health and Hazard

According to the interview survey to farmers, dengue, malaria, diarrhea etc. were pointed out as the commonly contracted diseases in the sub-project area. Insufficient knowledge among communities about the diseases is one of the main reasons for expansion of those. On the other hand, lack of water source particularly in dry season would be the reason for diarrhea disease. Situation of access to health and medical services in the sub-project area is shown as follows:

When you/your family get/gets sick, where do you go?

N=60

	Hospital	Clinic	Health Centre	Others
Number	3	0	53	4
Percentage	5.0%	-	88.3%	6.7%

Prepared by JICA Study Team based on Interview Survey carried out during the Study

Health Centre is the major medical facilities accessible to communities. Additionally, results

of the interview survey show that no interviewees have some kind of social security service/insurance.

4.3.4 Historical and Religious Sites

There are no archeological and/or historical significance in and/or around the Lum Hach Sub-Project area.

4.3.5 Economic Condition

(1) Main Economic Activity

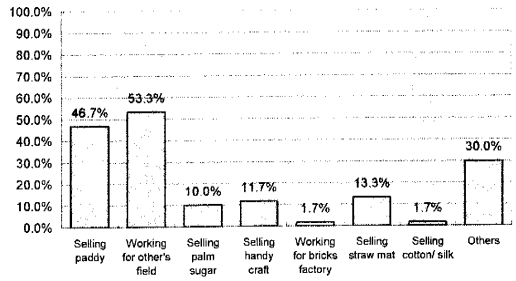
As shown in the following table, all the interviewee under the Lum Hach Sub-Project replied that the main economic activity is agriculture. Other activities observed in the community during field survey are: (i) collection of livestock raising, (ii) temporary workers for construction and (iii) kiosk selling vegetables and/or processed products for value-addition etc.

Main Activity of the Household

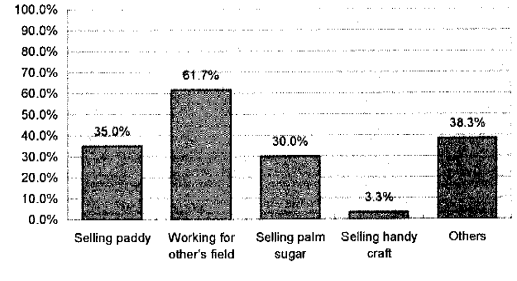
N=60

	Farmer	On-farm Labor	Non-Farm Labor	Salary Worker	Private Business	Others
Number	57	1	0	0	0	2
Percentage	95.0%	1.7%	-	-	-	3.3%

Prepared by JICA Study Team based on Interview Survey carried out during the Study



Main Cash Income Source (Female) (Plural Answer)



Main Cash Income Source (Male) (Plural Answer)

Working for their own farm and for assisting others occupies highest percentage for main cash income in both female and male under the sub-project. Other unique activities such as "selling handy craft" and/or "selling palm sugar" are also observed.

(2) Present Agriculture

The present agricultural conditions of the sub-project area have been studied on the basis of the results of interview survey with the major project commune offices and DAO Boribo, statistic data of DAO and PDA and findings of the field survey by the Study Team.

Rice production is the most important agricultural activities in the sub-project area and it is estimated that wet season rice cultivation in 2003 was practiced by about 98% of farm households. Rice production in the area is characterized by low and unstable productivity

under rainfed conditions or nearly rainfed conditions in coarse textured soils because of unstable and limited water supply. Further, the same is characterized by a single cropping of rice under transplanting method. Rice cultivation in the early wet and dry season is not practiced currently. The cultivation of vegetables in paddy field in the early wet season is reported, however, an area extent is limited. Further, prolonged rice cultivation season continuing form May/June to October/December with the cultivation of rice varieties of different growth durations of early to late and traditional farming practices are other characteristics of the rice production in the area.

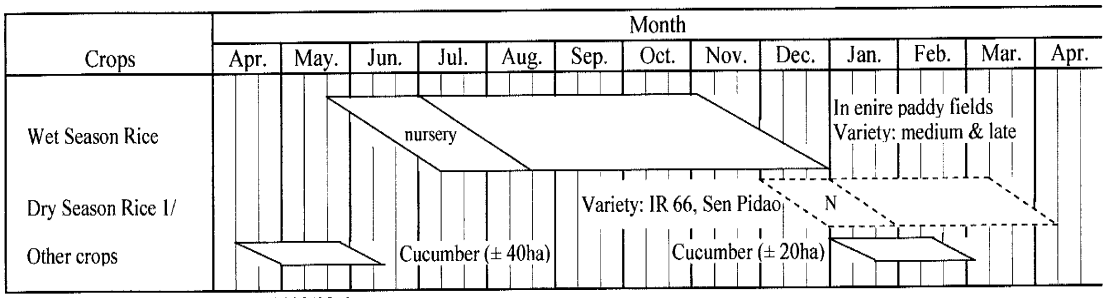
Rice cropping seasons in the sub-project area is similar to those in the sub-project areas in the Pursat River Basin and rice plants are grown from July/August to November/December in paddy fields under rainfed conditions. A number of rice varieties are cultivated and cropping seasons vary substantially depending on varieties grown. Major varieties grown in the area are as follows;

Major Varieties Grown in the Sub-project Area

Season	Growth Duration	Variety
Wet Season	Early	Sen Pidao
	Medium	Phka Rumduol, Phka Samley, Phka Sla
	Late	CAR 4, Neang Sor

Prepared by JICA Study Team

The prevailing cropping calendar in the area estimated based on the interview survey results is illustrated as shown in the following figure.



1/: In newly irrigated fields from 2008/09 dry season

Prepared by JICA Study Team

Prevailing Cropping Calendar in Paddy Fields: Lum Hach Sub-project Area

The current cropped areas of rice and other crops in the sub-project area have been estimated as follows.

Estimated Cropped Area & Cropping Intensity in the Sub-project Area

Cropping Season	Cropped Area (ha)		Cropping Intensity (%)
	Rice	Other Crops	
Wet Season	Intensity 100%	-	100
Early Wet Season	-	40	
Annual	Intensity 100%	40	

Note: the extent of the sub-project area is being finalized
Source: JICA Study Team

According to the Commune Survey on Crops & Livestock, 2003 presented by the Ministry of Agriculture, Forestry and Fisheries (MAFF), average cropped area of wet season rice per household is 1.5 ha.

(3) Local Living Standard

Local living standard were rapidly assessed by way of poverty ranking and focal group discussion. Poverty level was classified into four: (i) Destitute (poorest), (ii) Poor, (iii) Fair, and (iv) Rich. Poverty is multi-dimensional, complex, and each local community embraces different concepts of risks. Classification is, therefore, made from the view point of (i) income level, (ii) asset owned including land, (iii) education level, (iv) satisfaction level of basic human needs, and (v) financial transaction with financial institutions, and levels of each item are determined by the workshop attendants. The result is shown in Table 4.3.1 and summarized as follows showing that "Poor" and "Destitute" occupies 59 % of community members:

Income, its Source and Land Owned by Farmers at Lum Hach Rehabilitation Sub-Project

Classification	Number of Family	Percentage	1. Income		2. Asset
			Average Income per day (Riels)	Source of Income (main economic activity)	Land (ha)
Destitute	186F	9%	0-200	Labor	1
Poor	1,033F	50%	200-500	Land owner farmer and/or labor out of village	1 – 1.5
Fair	764F	37%	500-1500	Land owner farmer	1.5 - 5
Rich	83F	4%	>1500	Land Owner, Trader	>5
Total	2,066F	100%			

Prepared by JICA Study Team based on Workshop carried out during the Study

In relation to local economic conditions, land holding status was surveyed, results of which are as follows:

Status of Land Holding

N=60

	Owner Cultivator	Owner cum Sharecropper	Sharecropper	Owner cum Tenant	Tenant	Not Operating Any Farm
Number	60	0	0	0	0	0
Percentage	100.0%	-	-	-	-	-

Prepared by JICA Study Team based on Interview Survey carried out during the Study

All the farmers are categorized into "owner cultivator."

(4) Community-based Organizations

Community-based organizations are one of the important engines for supporting economic activities. The following table shows community-based organizations in which farmers currently are involved.

Member of Community-based Organization

N=60

	FWUC and/or Water Users' Group	Credit (Gov.)	Credit (NGOs)	Agriculture	Religion	Drinking Water	Market	Youth	Veteran	Women	No
Organization	0	0	0	0	0	0	0	0	0	0	60
Percentage	-	-	-	-	-	-	-	-	-	-	100.0%

Prepared by JICA Study Team based on Workshop carried out during the Study

Community-based organization here is inactive in the sub-project area. Since no water has been provided by deteriorated facilities, no FWUC and/or even water users' groups do not exist.

4.3.6 Present Water Use by Affected Communities

(1) Drinking and Domestic Water Use

Current sources of drinking and domestic water under the communities of the sub-project based on interview survey are tabulated as follows:

Drinking Water Source (Dry Season)

N=60

	Piped	Tube Pipe Well	Dug Well	Reservoir / Pond	Spring / River	Bought	Rain	Others
Number	1	2	51	2	0	0	0	4
Percentage	1.6%	3.4%	85.0%	3.4%	-	-	-	6.6%

Prepared by JICA Study Team based on Interview Survey carried out during the Study

Drinking Water Source (Wet Season)

N=60

	Piped	Tube Pipe Well	Dug Well	Reservoir / Pond	Spring / River	Bought	Rain	Others
Number	0	1	52	1	1	0	2	3
Percentage	-	1.6%	86.7%	1.6%	1.6%	-	3.4%	5.1%

Prepared by JICA Study Team based on Interview Survey carried out during the Study

Domestic Water Source (Dry Season)

N=60

	Piped	Tube Pipe Well	Dug Well	Reservoir / Pond	Spring / River	Bought	Rain	Others
Number	1	2	51	1	1	0	0	4
Percentage	1.6%	3.4%	85.0%	1.6%	1.6%	-	-	6.8%

Prepared by JICA Study Team based on Interview Survey carried out during the Study

Domestic Water Source (Wet Season)

N=60

	Piped	Tube Pipe Well	Dug Well	Reservoir / Pond	Spring / River	Bought	Rain	Others
Number	0	1	52	1	1	0	1	4
Percentage	-	1.6%	86.7%	1.6%	1.6%	-	1.7%	6.8%

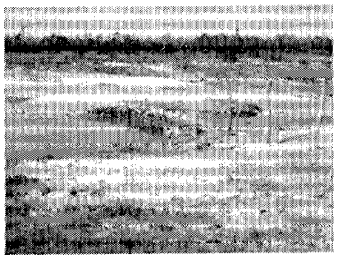
Prepared by JICA Study Team based on Interview Survey carried out during the Study

Main water source for drinking and domestic water among communities is dug well on which nearly 90 % of the respondents depend in both dry and wet season. Percentage of the people

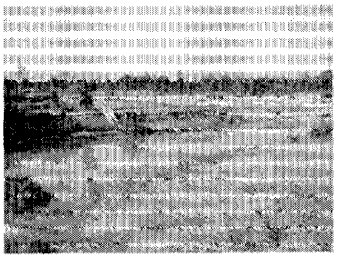
using river water for drinking and domestic purpose would be limited under the sub-project.

(2) Irrigation Water Use

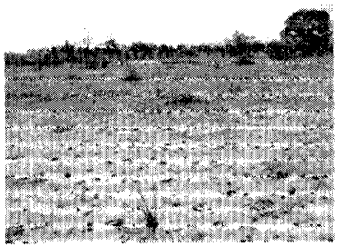
There is only makeshift check structure at the most upstream of the sub-project, therefore, water cannot be controlled for irrigation. Also, water level of the main canal, therefore, water cannot be irrigated by gravity so that farmers along the canal sometimes use pump to obtain supplemental water from the canal for their farm. In addition, development of secondary and tertiary canals and drains still lag behind. Irrigation water is, therefore, not stably distributed within the command area. Instead, farmers are only dependent on rainfall and flood water especially in the wet season.



Existing Makeshift Check Structure Constructed by Community Members (January 29th, 2008)



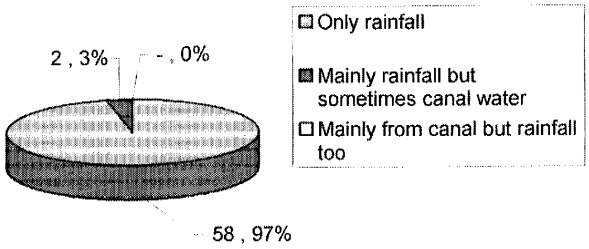
Existing Main Canal (January 29th, 2008)



Upland, not Irrigated by Gravity (January 29th, 2008)

Interview survey asking for present source of irrigation water and method of irrigation is illustrated as follows showing that nearly all the farmers rely only on rainfall at present. Therefore, rehabilitation of irrigation facilities particularly promotion of secondary and tertiary canals development will surely contribute to the constancy of irrigation water supply in the Sub-Project command area.

Under such conditions, farmers' groups are not functioning as a group for O&M of irrigation facilities and water management. As mentioned in 4.3.5, FWUC has been established, awareness and/recognition among farmers are quite low. In parallel with facilities rehabilitation, therefore, FWUC strengthening would be of critical importance for sustainable irrigation development and management.

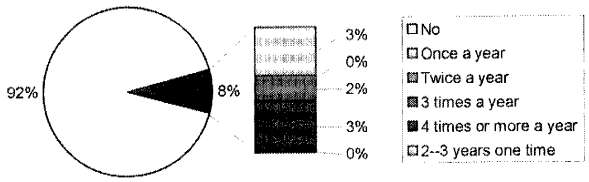


Prepared by JICA Study Team

What are the sources of irrigation water and the methods of irrigation to your paddy field?

(2) Flood Condition

Although it would be difficult to control and regulate, flood water is also an important source of water for agriculture. Necessity of flood management is huge in any irrigation development. In accordance with the interview survey, current flood condition is illustrated on the right showing that 8 % of the people are suffering from flooding at least once a year, water of which comes from the Boribo River. The asset damaged by flood is mostly reported to be paddy field.



N=60

Prepared by JICA Study Team

How often do you suffer from flood?

CHAPTER 5 STAKEHOLDERS OF THE PROJECT

5.1 Local Authorities and Institutions Involved

Institutional linkage and production-marketing flow process map was prepared through the public meeting in order to identify the "influence/benefit" as well as the "closeness" of institutions in surrounding areas of the sub-project toward seven communes: (i) Kraing Skear, (ii) Melum, (iii) Pro-Sneth, (iv) Pich Changva and Chak, (v) Phsar, (vi) Chanh Ruong and (vii) Khaon Rong and Popel under the Sub-Project as listed and illustrated in Figure 5.1.1 to Figure 5.1.8.

Participants Discussing Institutional Linkage with their Commune (January 28th, 2008)

Two communes generally pointed out lager influence from PDOWRAM, PDA and Provincial Department of Rural Development (PDRD). In addition, relation with MOE and DOE is also an important. Influence of credit organizations are not necessarily high, which depend upon the availability of collateral of farmers. Among others, ACLEDA and Prasac are the two main credit institutions for farmers as generally observed in rural areas of the country. NGOs' and/or donors' activities adhere to each commune rather than Sub-Project unit such as: (i) CEDAC, (ii) World Vision, (iii) SEILA Program, (iv) World Food Program, (v) HEAK etc. During the field survey, the Study Team visited PDOWRAM, PDOE and PDA to receive useful information for the Sub-Project. Relations with such institutions need to be fully considered for capacity development plan of environmental management.

5.2 Opinion of the Public Toward the Project

Workshop and public meetings were organized to formulate development plan of the sub-project.

Participants of Workshop and Public Consultation for Lum Hach Rehabilitation Sub-Project

No.	Organization	Participants
1.	National Counterparts and Steering Committee Member	Representative from MOWRAM (Department of Planning)
2.	Provincial Counterparts and Personnel Concerned	Director of PDOWRAM Kampong Chhnang, Chief of Meteorology Section, and Governor of Boribo District
3.	Commune Councils	Chiefs and the members of the councils (12 members: Lum Chach, Phsar I, Kraing Skear, Melum, Prosneth, Chak, Chagva and Anh Chanh Roung)
4.	JICA Study Team	Member of the Team
5.	Villagers	Villagers relevant to Lum Hach Rehabilitation Sub-Project (14 members: Kbal Thnaol, Prey Tamoung, Prey Tamoung, Trapaing Malu, Toul Samrong, Toul Roka, Prosneth, Chor, O-Rumchek, Tapang, Taing Trapaing, Anh Chanh Roung, Andong Roveang and Thlok Chrov)

Prepared by JICA Study Team

The result of participatory problem census, as tabulated below, shows that stable irrigation water supply is placed highest priority and of critical importance for farmers followed by farming-related constraints. Needs on road improvement is not negligible. Therefore, importance of irrigation rehabilitation together with inspection road under the Lum Hach irrigation sub-project command area was justified from the view point of public opinion.

Result of Participatory Problem Census by the Representative Farmers

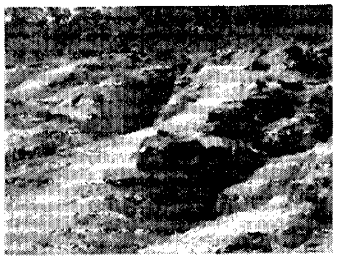
Rank	Problems	Problem Solution
I	Lack of water for irrigation	Request to rehabilitate irrigation scheme and need to participate for FWUG to manage, operate and maintenance of the scheme.
II	Lack of techniques for agriculture	Ask support from Ministry, Department and relevant institutions with the project to come for help, to send extension worker for agriculture to train the farmers at the sites.
III	Lack of animal for agriculture, Bad road to market	Ask support from Authorities to coordinate with the bank for the farmer can lend the money and can be organized community help each other.
IV	Bad road to market, Lack of animal for agriculture	Request to rehabilitate existing road to market for agriculture production.
V	Low quality of rice field	Ask for supporting from Ministry, Department and Institutional are related with the project to come for help, to send extension worker for agriculture to train the farmers at the sites.

Prepared by JICA Study Team

Through the discussion, although the Study is at the pre-feasibility level, sub-project component consisting of: (i) rehabilitation of irrigation and drainage facilities, (ii) FWUC establishment and strengthening and (iii) agricultural extension activities have been fully agreed by all the participants.

A participant mentioned concern of unequal distribution between the upstream and the downstream since the main and secondary canals of Lum Hach rehabilitation sub-project would be longer due to its layout. The team emphasized the importance of water management using rehabilitated facilities to achieve effective water management.

As covered by sandy soil, participants mentioned the seriousness of soil erosion under the command area, which would be, however, improved through drainage development.



Gully Erosion as Pointed Out by the Participants in the Workshop (January 29th, 2008)

Level of awareness for participation in irrigation O&M and water management was assessed through questionnaire survey as shown on the right, question contents of which are largely categorized into three: (i) participation in construction of tertiary facilities, (ii) participation in FWUC's activities and (iii) participation in O&M of irrigation system.

The result shows that the intention on the participation of construction works as well as O&M is comparatively strong among the participants. However,

awareness on the payment of FWUC fee remains low, which needs to be reoriented through the course of the sub-project.

MOWRAM is currently promoting Participatory Irrigation Management and Development (PIMD) through transferring responsibility of O&M at tertiary level facilities to farmers. In this connection, farmers' intention toward PIMD is important for sustainable irrigation management. Table 5.2.1 shows the discussion result regarding PIMD with the questions of:

(i) Who will be a prospective leader of FWUC?

(ii) Who can be a member of FWUC?

(iii) If irrigation system covers several communes, how will you organize FWUC?

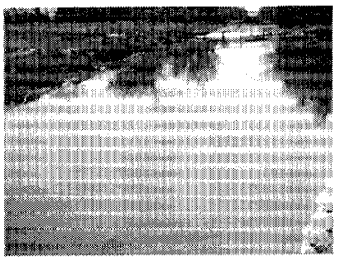
(iv) What kind of activities do you think required for FWUC in your project?

To improve efficiency in water resource utilization through the sub-project implementation, such opinions need to be considered for the assistance in the strengthening of FWUC at the Lum Hach Sub-Project.

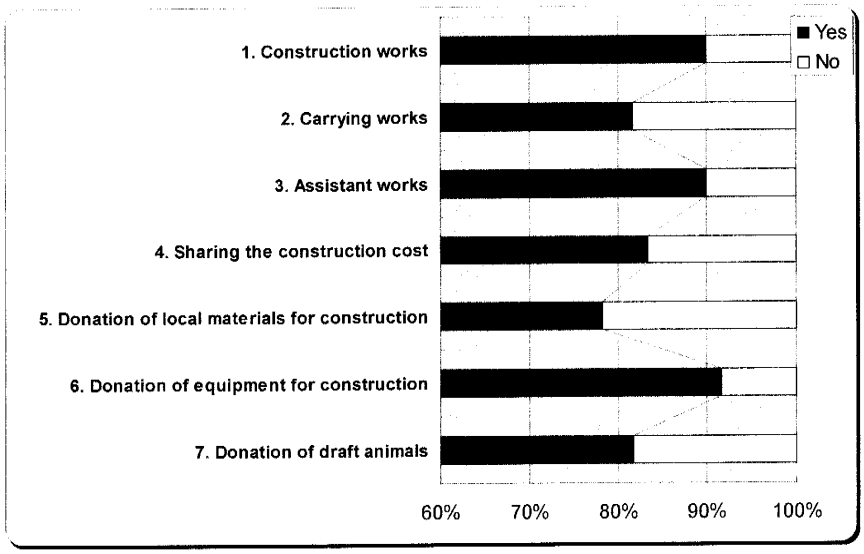
5.3 Present Environmental Issue

As part of the stakeholder consultation, current environmental issues were discussed and confirmed during the workshop from natural, social and other environment-related view points. As a result, it is confirmed that there are currently no serious environmental problems in and around the command area.

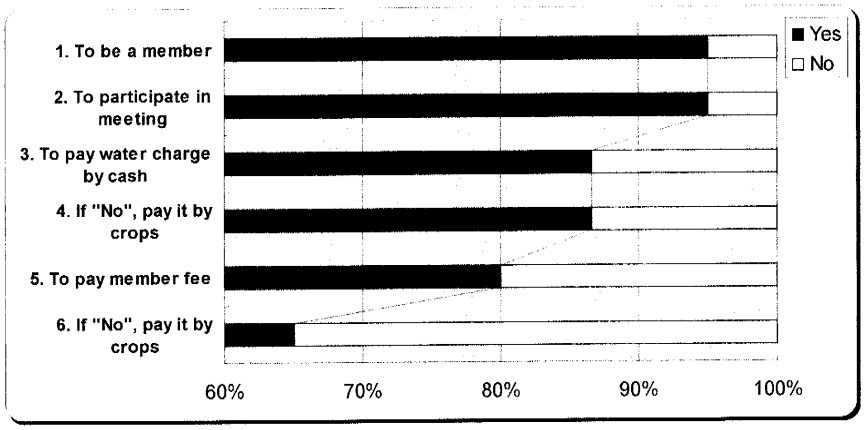
Social environmental issues were rather considered in the meeting. It is observed that the areas of main canal is partly utilized for cultivation and/or fishing. Although farmers have really understood that such activities are drawn up before the commencement of the construction works according to the discussion in the workshop, proper steps and mitigation measures are required for consensus building among relevant institutions and farmers. In addition, at present, no secondary and tertiary level facilities developed. Consensus building for land acquisition is also an important issue to promote development of the tertiary level facilities.



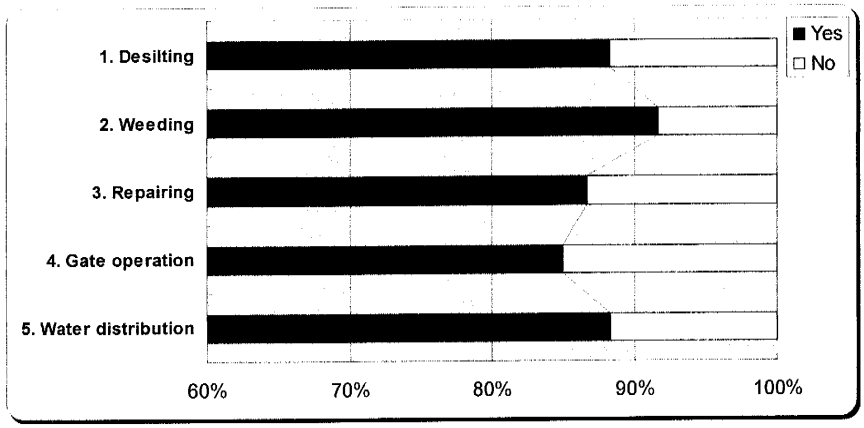
Fish Pond Operated in the Main Canal by Community Members
(January 29th, 2008)



Participation in Construction of Tertiary Facilities



Participation in FWUC's Activities



Participation in O&M of Irrigation System

N=40

Prepared by JICA Study Team based on Field Interview

Level of Awareness for Participation in Irrigation O&M and Water Management

CHAPTER 6 INITIAL ENVIRONMENTAL IMPACT ASSESSMENT

6.1 General

(1) Screening of the Sub-Project Component

Sub-project components primarily consist of: (i) rehabilitation and improvement of irrigation and drainage facilities, (ii) FWUC establishment and strengthening and (iii) agriculture support. Main subjects of FWUC establishment and strengthening and agriculture support are: (i) awareness program, (ii) module development, (iii) training and (iv) small-scale pilot exercise in agriculture and irrigation rehabilitation, therefore, adverse potential impact toward environment in and around the sub-project area is completely none or negligible or small. Thus activities (ii) and (iii) are screened out from IEIA. IEIA in this report concentrates on potential impact from the rehabilitation and the improvement of irrigation and drainage facilities.

(2) Scoping

An IEIA is carried out using matrix focusing on the aspect of: (i) social environment, (ii) natural environment and (iii) pollution as listed as follows on the basis of proposed component:

Social Environment

1. Involuntary resettlement
2. Local economy (employment and income generation)
3. Land use and resource mobilization
4. Social capital and traditional institution
5. Social infrastructure and services
6. The poor, indigenous and minority group
7. Unequal distribution of damage and benefit
8. Cultural heritage
9. Local conflict over interest
10. Water use
11. Sanitation
12. Risk against infectious diseases

Natural Environment

13. Topography and geographical features
14. Soil erosion
15. Groundwater
16. Hydrology
17. Coastal area such as mangrove, coral reef and tidal area
18. Flora, fauna and biodiversity
19. Meteorology
20. Landscape
21. Global warming

Pollution

22. Air pollution

23. Water pollution
24. Soil Contamination
25. Waste
26. Noise and vibration
27. Ground subsidence
28. Offensive odor
29. Sedimentation
30. Accidents

The result of IEIA is summarized in Table 6.1.1 for: (i) stage-wise impact, (ii) reason, (iii) mitigation measures and (iv) method and timing for monitoring. For the facilitation of understanding, mitigation measures, as detailed in Chapter 7, are also summarized in this matrix so that negative impact and mitigation measures are easily compared as the essence of IEIA.

6.2 Potential Negative Environmental Impact

Prospective negative environmental impacts identified are listed as follows:

Social Environment

(i) Involuntary resettlement;

(ii) Local conflict over interest;

(iii) Water use;

(iv) Sanitation;

(v) Risk against infectious diseases;

Natural Environment

(i) Coastal area such as mangrove, coral reef and tidal area;

(ii) Flora, fauna and biodiversity;

Pollution

(i) Air pollution;

(ii) Water pollution;

(iii) Soil contamination;

(iv) Waste;

(v) Noise and vibration; and

(vi) Accidents.

Brief description of each negative impact is shown in the following table.

Potential Negative Environmental Impact

Item		Stage		
		Preparation	Construction	O&M
Social Environment	Involuntary Resettlement	Land acquisition by the expansion and/or new construction of canals and drains (main, secondary and tertiary canals)	-	-
	Local Conflict Over Interest	-	Conflict among construction labors and farmers	Conflict over unequal water use within the sub-project command area and with other sub-projects (Damnak Ampil and Wat Loung)
	Water Use	-	Reduction of drinking, domestic and irrigation water by the Headworks construction in the River	-
	Sanitation	-	Due to inflow of labors from outside	-
	Risk against Infectious Diseases	-	Due to inflow of labors from outside	-
Natural Environment	Coastal area such as Mangrove, Coral Reef and Tidal Area	-	-	Increase in chemicals and fertilizers application
	Flora, Fauna and Biodiversity	-	Disturbance of fish sprawling by construction works	Disturbance of fish sprawling by construction works
Pollution	Air Pollution	-	Dust and emission gas from construction works	-
	Water Pollution	-	Waste water increase from construction works	Acceleration of nutrient load and/or chemical contamination in drainage water due to increase in chemicals and fertilizers application
	Soil Contamination	-	-	Misuse and/or excessive usage of chemicals and fertilizers
	Waste	-	Improper disposal of waste from construction works	-
	Noise and vibration	-	Due to construction machinery	-
	Accidents	-	Due to construction machinery	-

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